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AF/2834

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

Clark T.-C. Nguyen

Serial No.: 09/839,436

Filed: April 20, 2001

Group Art Unit: 2834

Examiner: Thomas M. Dougherty

For: METHOD AND APPARATUS FOR FILTERING SIGNALS UTILIZING A VIBRATING MICROMECHANICAL RESONATOR

Attorney Docket No.: UOM 0233 PUS

APPEAL BRIEF AND PETITION FOR EXTENSION OF TIME UNDER 37 C.F.R. § 1.136(a)

Mail Stop Appeal Brief - Patents
Commissioner for Patents
U.S. Patent & Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Applicant hereby petitions for a one month extension of time to respond to the Notice of Appeal received by the U.S. Patent and Trademark Office on May 9, 2003, thereby extending the time period within which to respond to August 9, 2003.

This is an appeal brief from the final rejection of claims 1-32 of the Final Office Action dated February 7, 2003. This application was filed on April 20, 2001.

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REMARKS

This application is a continuation-in-part of U.S. patent application entitled "Device Including A Micromechanical Resonator Having An Operating Frequency And Method Of Extending Same" filed January 13, 2000, having U.S. Serial No. 09/482,670, now issued as U.S. Patent No. 6,249,073 (hereinafter parent application), a copy of which is included for reference in the Appendix. The present application is directed to a "Method and Apparatus for Filtering Signals Utilizing a Vibrating Micromechanical Resonator." In essence, the present application claims a filter apparatus utilizing the patented micromechanical resonator of the parent application. Applicants' representative is concerned that the Examiner has called into question the patentability of the present application in view of the presumed validity of the issued U.S. Patent No. 6,249,073 (i.e., the parent application).

In particular, the references cited by the Examiner in the rejection of the presently pending application under 35 U.S.C. § 102(b) (i.e., C. T.-C. Nguyen and R. T. Howe, "Design and performance of CMOS micromechanical resonator oscillators," Proceedings, 1994 IEEE International Frequency Control Symposium, Boston, MA, May 31-June 3, 1994, pp. 127-134, and U.S. Patent No. 5,537,083 to Lin et al.) were considered by the same Examiner in the parent application. (See, U.S. Patent No. 6,249,073, item 56, References Cited). In fact, C. T.-C. Nguyen, a co-author of the cited article titled "Design and performance of CMOS micromechanical resonator oscillators" is the inventor of the presently pending invention. As such, both references, and particularly the article, were well known and fully considered by the inventor. (See, for example, page 6, ll. 18-20 of the present application).

As is argued in detail below, the Examiner has failed to provide evidence that the presently pending application is anticipated by the cited references. Applicant submits that the allowance of the parent application in view of the cited references provides additional

evidence of the patentability of the presently pending application. In particular, the claims in the presently pending application provide limitations that render the present application separately patentable from the parent application as well as fully patentable over the cited references. As such, Applicant's representative fails to understand how the patentability of the present application is called into question by the Examiner. Clarification is respectfully requested.

I. REAL PARTY IN INTEREST

The real parties in interest are the assignee, which is the Regents of the University of Michigan, a non-profit organization, organized and existing under the laws of the state of Michigan, and having a place of business at 3003 S. State Street, Ann Arbor, Michigan 48109, as set forth in the assignment recorded in the U.S. Patent and Trademark Office on July 12, 2001 at Reel 011734/Frame 0534, and an exclusive licensee, Ardesta, LLC, a corporation, organized and existing under the laws of the state of Michigan, and having a place of business at 755 Phoenix Drive, Ann Arbor, Michigan 48108.

II. RELATED APPEALS AND INTERFERENCES

There are no appeals or interferences known to appellant, the appellant's legal representative, or assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 1-32 are pending in this application. Claims 1-32 have been finally rejected and are the subject of this appeal. The claims that are the subject matter of this appeal are reproduced in Appendix A.

IV. STATUS OF AMENDMENTS

An amendment in response to a non-final rejection was filed on August 27, 2002, and has been accepted for entry. There are no amendments pending in the present application.

V. SUMMARY OF THE INVENTION

In a first embodiment, the present invention provides a method for filtering signals to obtain a desired passband of frequencies, the method comprising providing a micromechanical filter apparatus including a micromechanical resonator having a fundamental resonant mode formed on a substrate and a support structure anchored to the substrate to support the resonator above the substrate, and vibrating the resonator so that the apparatus passes a desired frequency range of signals while substantially attenuating signals outside the desired frequency range, wherein the support structure is attached to the resonator and the support structure and the resonator are both dimensioned so that the resonator is isolated from the support structure during resonator vibration, wherein energy losses to the substrate are substantially eliminated and wherein the apparatus is a high-Q apparatus. (See, for example, Figures 5a, 6, 9, 10, 15 and 17a, and the specification on page 15, ll. 15-29, page 18, ll. 19-29, and page 22, l. 28 - page 25, l. 6).

In a second embodiment, the present invention provides a micromechanical filter apparatus for filtering signals to obtain a desired passband of frequencies, the apparatus comprising a substrate, a first micromechanical resonator, and a support structure anchored to the substrate to support the resonator above the substrate wherein the support structure and the resonator are both dimensioned so that the resonator is isolated from the support structure during resonator vibration wherein energy losses to the substrate are substantially eliminated and wherein the apparatus is a high-Q apparatus. (See, for example, Figures 5a, 6, 9, 10, 15

and 17a, and the specification on page 15, ll. 15-29, page 18, ll. 19-29, and page 22, l. 28 - page 25, l. 6).

In a third embodiment, the present invention provides a micromechanical filter apparatus for filtering signals to obtain a desired passband of frequencies, the apparatus comprising a substrate, a plurality of intercoupled micromechanical elements capable of resonant vibration, and a support structure anchored to the substrate to support the elements above the substrate wherein the support structure and the elements are attached at one or more locations sustaining substantially no translational movement during resonant vibration of the elements. (See, for example, Figures 5a, 6, 9, 10, 15 and 17a, and the specification on page 15, ll. 15-29, page 18, ll. 19-29, and page 22, l. 28 - page 25, l. 6).

In a fourth embodiment, the present invention provides a micromechanical filter apparatus for filtering signals to obtain a desired passband of frequencies, the apparatus comprising a substrate, a plurality of intercoupled micromechanical elements capable of resonant vibration, and a support structure anchored to the substrate to support the elements above the substrate wherein the support structure comprises a support beam, and wherein the support beam is attached to the elements such that the support beam sustains substantially no translational movement during resonant vibration of the elements. (See, for example, Figures 5a, 6, 9, 10, 15 and 17a, and the specification on page 15, ll. 15-29, page 18, ll. 19-29, and page 22, l. 28 - page 25, l. 6).

VI. ISSUES

1. Claims 1, 5, 7-9, 11, 13, 15 and 19-32 were rejected under 35 U.S.C. § 102(b) as being anticipated by C. T.-C. Nguyen and R. T. Howe, "Design and performance of CMOS micromechanical resonator oscillators," Proceedings, 1994 IEEE International Frequency Control Symposium, Boston, MA, May 31-June 3, 1994, pp. 127-134 (hereinafter

Nguyen). The first issue is whether the Examiner properly rejected claims 1, 5, 7-9, 11, 13, 15 and 19-32 as being anticipated by Nguyen.

2. Claims 1-13 and 15-28 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,537,083 to Lin et al. (hereinafter Lin). The second issue is whether the Examiner properly rejected claims 1-13 and 15-28 as being anticipated by Lin.

VII. GROUPING OF CLAIMS

Applicant contends that the claims do not stand or fall together. In particular, Applicant contends the claims may be grouped as follows:

1. Claims 1, 2-4 and 26 (Group 1) stand or fall together.

2. Claims 5-25 and 27 (Group 2) stand or fall together.

3. Claims 28-30 (Group 3) stand or fall together.

4. Claims 31 and 32 (Group 4) stand or fall together.

As is argued in detail below, Groups 1-4 are independently patentable. In particular, the claims in each of the Groups provide limitations that are separately patentable over the cited art from the other Groups. In addition, claims 29 and 30 of Group 3, and Group 4 (claims 31 and 32) were not included in the rejection under 35 U.S.C. § 102(b) as being anticipated by Lin.

VIII. ARGUMENT

1. The Examiner improperly rejected claims 1, 5, 7-9, 11, 13, 15 and 19-32 under 35 U.S.C. § 102(b) as being anticipated by Nguyen

The Examiner has rejected claims 1, 5, 7-9, 11, 13, 15 and 19-32 under 35 U.S.C. § 102(b) as being anticipated by Nguyen. However, the Examiner has failed to establish anticipation under 35 U.S.C. § 102(b) and the rejection should, therefore, be reversed. In that regard, "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference". (Manual of Patent Examining Procedure (MPEP), 8th Edition, August 2001, revised February 2003, § 2131 (citing *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987)). Furthermore, "The identical invention must be shown in as complete detail as is contained in the ... claim". (MPEP, § 2131 (citing *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989)).

A. The Examiner improperly rejected Group 1 (claims 1, 2-4 and 26) as being anticipated by Nguyen

Claim 1 provides, in particular, vibrating a resonator so that an apparatus passes a desired frequency range of signals while substantially attenuating signals outside the desired frequency range, and that both the support structure and the resonator are dimensioned so that the resonator is isolated from the support structure during resonator vibration wherein energy losses to the substrate are substantially eliminated and wherein the apparatus is a high-Q apparatus.

The Examiner asserts that Nguyen "shows...the support structure is attached to the resonator and the support structure and the resonator are both dimensioned so that the

resonator is isolated from the support structure during resonator vibration where energy losses to the substrate are substantially eliminated". (Office Action mailed October 2, 2002 on page 2, l. 15 - page 3, l. 3). Applicant respectfully disagrees with the Examiner's characterization of Nguyen.

In particular, the Examiner has mis-characterized the teachings of Nguyen. Nowhere does the Examiner provide evidence to support the characterization of Nguyen that is asserted (i.e., the Examiner has failed to provide any cite in Nguyen to support the characterization that is asserted). In fact, the Examiner asserts that Nguyen shows "a support structure comprising a first support beam and a second support beam attached to first and second resonant beams". (Office Action mailed October 2, 2002 on page 3, ll. 14-18). However, the Figure referenced by the Examiner (i.e., Nguyen, Fig. 4) shows a clamped-clamped beam device. Clamped-clamped devices, by definition, have a resonant element that is clamped at either end by a respective support structure. As a result, the resonant element is not isolated from the respective support structure, but rather connected directly to the support structure. Fig. 4 of Nguyen shows such a direct connection in a folded-beam configuration. More particularly, the clamped-clamped beam design consists of a folded-beam suspension that is supported at two central points, labeled "Anchor" in Fig. 4. During resonant vibration, interior and exterior beams of the folded-beam suspension experience displacement in the x-direction (i.e., "the direction indicated [in Fig. 4], parallel to the plane of the silicon substrate"). Such displacement is undesirably damped, however, because the interior beams are directly connected to the two anchors. The resonant element is said to be "clamped" at the anchors, and therefore not at all isolated from the support structure.

In contrast, presently pending claim 1 provides a support structure that is attached to the resonator, and the support structure and the resonator are both dimensioned so that the resonator is isolated from the support structure during resonator vibration where energy losses to the substrate are substantially eliminated. Nowhere does Nguyen disclose,

teach or suggest the support structure and the resonator are dimensioned so that the resonator is isolated from the support structure during resonator vibration wherein energy losses to the substrate are substantially eliminated. Furthermore, the present invention is not limited to movement only in the direction that the fingers extend as in the structure taught by Nguyen.

Consequently, the prior art simply fails to teach, disclose or discuss a resonator and a support structure both dimensioned so that the resonator is isolated from the support structure during resonator vibration such that energy losses to the substrate are substantially eliminated and the apparatus is a high-Q apparatus. As such, the Examiner has failed to establish that presently pending claim 1 is anticipated by Nguyen, and the rejection under 35 U.S.C. § 102 should, therefore, be reversed.

Regarding the claims of Group 1 which depend from claim 1, Applicant contends that these claims are patentable for at least the same reasons that claim 1 is patentable. Moreover, Applicant contends that these claims recite further limitations, in addition to the limitations of claim 1, which render these claims additionally patentable.

B. The Examiner improperly rejected Group 2 (claims 5-25 and 27) as being anticipated by Nguyen

Claim 5 provides, in particular, a support structure and a resonator that are dimensioned so that the resonator is isolated from the support structure during resonator vibration wherein energy losses to the substrate are substantially eliminated and wherein the apparatus is a high-Q apparatus.

The Examiner asserts that Nguyen "shows...the support structure is attached to the resonator and the support structure and the resonator are both dimensioned so that the resonator is isolated from the support structure during resonator vibration where energy losses

to the substrate are substantially eliminated". (Office Action mailed October 2, 2002 on page 2, l. 15 - page 3, l. 3). Applicant respectfully disagrees with the Examiner's characterization of Nguyen.

In particular, the Examiner has mis-characterized the teachings of Nguyen. Nowhere does the Examiner provide evidence to support the characterization of Nguyen that is asserted (i.e., the Examiner has failed to provide any cite in Nguyen to support the characterization that is asserted). In fact, the Examiner asserts that Nguyen shows "a support structure comprising a first support beam and a second support beam attached to first and second resonant beams". (Office Action mailed October 2, 2002 on page 3, ll. 14-18). However, the Figure referenced by the Examiner (i.e., Nguyen, Fig. 4) shows a clamped-clamped beam device. Clamped-clamped devices, by definition, have a resonant element that is clamped at either end by a respective support structure. As a result, the resonant element is not isolated from the respective support structure, but rather connected directly to the support structure. Fig. 4 of Nguyen shows such a direct connection in a folded-beam configuration. More particularly, the clamped-clamped beam design consists of a folded-beam suspension that is supported at two central points, labeled "Anchor" in Fig. 4. During resonant vibration, interior and exterior beams of the folded-beam suspension experience displacement in the x-direction (i.e., "the direction indicated [in Fig. 4], parallel to the plane of the silicon substrate"). Such displacement is undesirably damped, however, because the interior beams are directly connected to the two anchors. The resonant element is said to be "clamped" at the anchors, and therefore not at all isolated from the support structure.

In contrast, presently pending claim 5 provides a support structure that is attached to the resonator, and the support structure and the resonator are both dimensioned so that the resonator is isolated from the support structure during resonator vibration where energy losses to the substrate are substantially eliminated. Nowhere does Nguyen disclose, teach or suggest the support structure and the resonator are dimensioned so that the resonator

is isolated from the support structure during resonator vibration wherein energy losses to the substrate are substantially eliminated. Furthermore, the present invention is not limited to movement only in the direction that the fingers extend as in the structure taught by Nguyen.

Consequently, the prior art simply fails to teach, disclose or discuss a resonator and a support structure both dimensioned so that the resonator is isolated from the support structure during resonator vibration such that energy losses to the substrate are substantially eliminated and the apparatus is a high-Q apparatus. As such, the Examiner has failed to establish that presently pending claim 5 is anticipated by Nguyen, and the rejection under 35 U.S.C. § 102 should, therefore, be reversed.

Regarding the claims of Group 2 which depend from claim 5, Applicant contends that these claims are patentable for at least the same reasons that claim 5 is patentable. Moreover, Applicant contends that these claims recite further limitations, in addition to the limitations of claim 5, which render these claims additionally patentable.

C. The Examiner improperly rejected Group 3 (claims 28-30) as being anticipated by Nguyen

Claim 28 provides, in particular, a support structure and elements that are attached at one or more locations sustaining substantially no translational movement during resonant vibration of the elements.

Nowhere in the Office Actions mailed October 2, 2002 and February 7, 2003 does the Examiner provide evidence that Nguyen discloses, teaches or suggests a support structure and elements that are attached at one or more locations sustaining substantially no translational movement during resonant vibration of the elements as claimed in presently pending claim 28. The Examiner asserts that Nguyen "shows...the support structure is

attached to the resonator and the support structure and the resonator are both dimensioned so that the resonator is isolated from the support structure during resonator vibration where energy losses to the substrate are substantially eliminated". (Office Action mailed October 2, 2002 on page 2, l. 15 - page 3, l. 3). The Examiner further asserts the conclusory remark that Nguyen "show[s] the claimed structure". (Office Action mailed October 2, 2002 on page 3, ll. 16-17). Applicant respectfully disagrees with the Examiner's characterization of Nguyen.

In particular, nowhere does the Examiner provide evidence to support the characterization of Nguyen that is asserted (i.e., the Examiner has failed to provide any cite in Nguyen to support the characterization that is asserted). Nowhere does Nguyen disclose, teach or suggest a support structure and elements that are attached at one or more locations sustaining substantially no translational movement during resonant vibration of the elements, as recited in presently pending claim 28. To the contrary, Nguyen discloses a clamped-clamped device, which, as described above in connection with Group 1, includes interior suspended beams connected directly to a support structure, namely the anchors. Nevertheless, the interior beams experience lateral displacement during resonant vibration such that the lateral beams do, in fact, experience translational movement.

Consequently, the prior art simply fails to teach, disclose or discuss a support structure and elements that are attached at one or more locations sustaining substantially no translational movement during resonant vibration of the elements, and in fact, the prior art teaches the shuttle mass is free to move translationally. As such, the Examiner has failed to establish that presently pending claim 28 is anticipated by Nguyen, and the rejection under 35 U.S.C. § 102 should, therefore, be reversed.

Regarding the claims of Group 3 which depend from claim 28, Applicant contends that these claims are patentable for at least the same reasons that claim 28 is

patentable. Moreover, Applicant contends that these claims recite further limitations, in addition to the limitations of claim 28, which render these claims additionally patentable.

D. The Examiner improperly rejected Group 4 (claims 31 and 32) as being anticipated by Nguyen

Claim 31 provides, in particular, a support structure anchored to a substrate to support a plurality of intercoupled micromechanical elements above the substrate wherein the support structure comprises a support beam, and wherein the support beam is attached to the elements such that the support beam sustains substantially no translational movement during resonant vibration of the elements.

Nowhere in the Office Actions mailed October 2, 2002 and February 7, 2003 does the Examiner provide evidence that Nguyen discloses, teaches or suggests a support structure anchored to a substrate to support a plurality of intercoupled micromechanical elements above the substrate wherein the support structure comprises a support beam, and wherein the support beam is attached to the elements such that the support beam sustains substantially no translational movement during resonant vibration of the elements as claimed in presently pending claim 31. The Examiner asserts that Nguyen "shows...the support structure is attached to the resonator and the support structure and the resonator are both dimensioned so that the resonator is isolated from the support structure during resonator vibration where energy losses to the substrate are substantially eliminated". (Office Action mailed October 2, 2002 on page 2, l. 15 - page 3, l. 3). The Examiner further asserts the conclusory remark that Nguyen "show[s] the claimed structure". (Office Action mailed October 2, 2002 on page 3, ll. 16-17). Applicant respectfully disagrees with the Examiner's characterization of Nguyen.

In particular, nowhere does the Examiner provide evidence to support the characterization of Nguyen that is asserted (i.e., the Examiner has failed to provide any cite in Nguyen to support the characterization that is asserted). Nowhere does Nguyen disclose, teach or suggest a support structure anchored to a substrate to support a plurality of intercoupled micromechanical elements above the substrate wherein the support structure comprises a support beam, and wherein the support beam is attached to the elements such that the support beam sustains substantially no translational movement during resonant vibration of the elements, as recited in presently pending claim 31. To the contrary, Nguyen discloses a clamped-clamped device, which, as described above in connection with Group 1, includes interior suspended beams connected directly to a support structure, namely the anchors. Nevertheless, the interior beams experience lateral displacement during resonant vibration such that the lateral beams do, in fact, experience translational movement.

Consequently, the prior art simply fails to teach, disclose or discuss a support structure anchored to a substrate to support a plurality of intercoupled micromechanical elements above the substrate wherein the support structure comprises a support beam, and wherein the support beam is attached to the elements such that the support beam sustains substantially no translational movement during resonant vibration of the elements, and in fact, the prior art teaches the shuttle mass is free to move translationally. As such, the Examiner has failed to establish that presently pending claim 31 is anticipated by Nguyen, and the rejection under 35 U.S.C. § 102 should, therefore, be reversed.

Regarding claim 32 which depends from claim 31, Applicant contends that this claim is patentable for at least the same reasons that claim 31 is patentable. Moreover, Applicant contends that this claims recites further limitations, in addition to the limitations of claim 31, which render this claim additionally patentable.

2. The Examiner improperly rejected claims 1-13 and 15-28 under 35 U.S.C. § 102(b) as being anticipated by Lin

The Examiner has rejected claims 1-13 and 15-28 under 35 U.S.C. § 102(b) as being anticipated by Lin. However, the Examiner has failed to establish anticipation under 35 U.S.C. § 102(b) and the rejection should, therefore, be reversed. In that regard, "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference". (Manual of Patent Examining Procedure (MPEP), 8th Edition, August 2001, revised February 2003, § 2131 (citing *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987)). Furthermore, "The identical invention must be shown in as complete detail as is contained in the ... claim". (MPEP, § 2131 (citing *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989)).

A. The Examiner improperly rejected Group 1 (claims 1, 2-4 and 26) as being anticipated by Lin

Claim 1 provides, in particular, vibrating a resonator so that an apparatus passes a desired frequency range of signals while substantially attenuating signals outside the desired frequency range, and that both the support structure and the resonator are dimensioned so that the resonator is isolated from the support structure during resonator vibration wherein energy losses to the substrate are substantially eliminated and wherein the apparatus is a high-Q apparatus.

The Examiner asserts that Lin discloses " the support structure and the resonator are both dimensioned so that the resonator is isolated from the support structure during resonator vibration". (Office Action mailed October 2, 2002 on page 4, ll. 6-7). Applicant respectfully disagrees with the Examiner's characterization of Lin.

In particular, the Examiner has mis-characterized the teachings of Lin. Nowhere does the Examiner provide evidence to support the characterization of Lin that is asserted (i.e., the Examiner has failed to provide any cite in Lin to support the characterization that is asserted). In fact, the Figure referenced by the Examiner (i.e., Lin, Fig. 6A) shows a clamped-clamped beam (i.e., each suspension flexure is anchored to the substrate by a pair of anchors at the interior ends of inner arms). (Lin, Fig. 6a and col. 5, ll. 1-2). The clamped-clamped configuration is identical to the design disclosed in Nguyen (described above) in the sense that the structure consists of inner arms or beams directly attached to the anchors. When the inner arms are displaced laterally during resonant vibration, the resonant element is not isolated from the respective support structure, and energy is lost to the damping provided by the anchors.

In contrast, presently pending claim 1 provides a support structure and a resonator are dimensioned so that the resonator is isolated from the support structure during resonator vibration wherein energy losses to the substrate are substantially eliminated. Nowhere does Lin disclose, teach or suggest the support structure and the resonator are dimensioned so that the resonator is isolated from the support structure during resonator vibration wherein energy losses to the substrate are substantially eliminated. Furthermore, the present invention is not limited to movement only in the direction that the fingers extend as in the structure taught by Lin.

Consequently, the prior art simply fails to teach, disclose or discuss a resonator and a support structure both dimensioned so that the resonator is isolated from the support structure during resonator vibration such that energy losses to the substrate are substantially eliminated and the apparatus is a high-Q apparatus. As such, the Examiner has failed to establish that presently pending claim 1 is anticipated by Lin, and the rejection under 35 U.S.C. § 102 should, therefore, be reversed.

Regarding the claims of Group 1 which depend from claim 1, Applicant contends that these claims are patentable for at least the same reasons that claim 1 is patentable. Moreover, Applicant contends that these claims recite further limitations, in addition to the limitations of claim 1, which render these claims additionally patentable.

B. The Examiner improperly rejected Group 2 (claims 5-25 and 27) as being anticipated by Lin

Claim 5 provides, in particular, a support structure and a resonator that are dimensioned so that the resonator is isolated from the support structure during resonator vibration wherein energy losses to the substrate are substantially eliminated and wherein the apparatus is a high-Q apparatus.

The Examiner asserts that Lin discloses " the support structure and the resonator are both dimensioned so that the resonator is isolated from the support structure during resonator vibration". (Office Action mailed October 2, 2002 on page 4, ll. 6-7). Applicant respectfully disagrees with the Examiner's characterization of Lin.

In particular, the Examiner has mis-characterized the teachings of Lin. Nowhere does the Examiner provide evidence to support the characterization of Lin that is asserted (i.e., the Examiner has failed to provide any cite in Lin to support the characterization that is asserted). In fact, the Figure referenced by the Examiner (i.e., Lin, Fig. 6A) shows a clamped-clamped beam (i.e., each suspension flexure is anchored to the substrate by a pair of anchors at the interior ends of inner arms). (Lin, Fig. 6a and col. 5, ll. 1-2). The clamped-clamped configuration is identical to the design disclosed in Nguyen (described above) in the sense that the structure consists of inner arms or beams directly attached to the anchors. When the inner arms are displaced laterally during resonant vibration, the resonant element is

not isolated from the respective support structure, and energy is lost to the damping provided by the anchors.

In contrast, presently pending claim 5 provides a support structure that is attached to the resonator, and the support structure and the resonator are both dimensioned so that the resonator is isolated from the support structure during resonator vibration where energy losses to the substrate are substantially eliminated, as presently claimed. Nowhere does Lin disclose, teach or suggest the support structure and the resonator are dimensioned so that the resonator is isolated from the support structure during resonator vibration wherein energy losses to the substrate are substantially eliminated, as recited in presently pending claim 5. Furthermore, the present invention is not limited to movement only in the direction that the fingers as in the structure taught by Lin.

Consequently, the prior art simply fails to teach, disclose or discuss a resonator and a support structure both dimensioned so that the resonator is isolated from the support structure during resonator vibration such that energy losses to the substrate are substantially eliminated and the apparatus is a high-Q apparatus. As such, the Examiner has failed to establish that presently pending claim 5 is anticipated by Lin, and the rejection under 35 U.S.C. § 102 should, therefore, be reversed.

Regarding the claims of Group 2 which depend from claim 5, Applicant contends that these claims are patentable for at least the same reasons that claim 5 is patentable. Moreover, Applicant contends that these claims recite further limitations, in addition to the limitations of claim 5, which render these claims additionally patentable.

C. The Examiner improperly rejected Group 3 (claims 28-30) as being anticipated by Lin

Claim 28 provides, in particular, a support structure and elements that are attached at one or more locations sustaining substantially no translational movement during resonant vibration of the elements.

Nowhere in the Office Actions mailed October 2, 2002 and February 7, 2003 does the Examiner provide evidence that Lin discloses, teaches or suggests a support structure and elements that are attached at one or more locations sustaining substantially no translational movement during resonant vibration of the elements as claimed in presently pending claim 28. The Examiner asserts that Lin discloses "The support structure includes a plurality of beams and the resonator includes a plurality of nodal points and wherein each of the beams is attached to the resonator at one of the nodal points of the resonator so that the resonator sees substantially no resistance (note that the device vibrates freely) to transverse or torsional motion from the support structure". (Office Action mailed October 2, 2002 on page 5, ll. 16-22). Applicant respectfully disagrees with the Examiner's characterization of Lin.

In particular, nowhere does the Examiner provide evidence to support the characterization of Lin that is asserted (i.e., the Examiner has failed to provide any cite in Lin to support the characterization that is asserted). Nowhere does Lin disclose, teach or suggest a support structure and elements that are attached at one or more locations sustaining substantially no translational movement during resonant vibration of the elements, as recited in presently pending claim 28. To the contrary, Lin discloses a clamped-clamped beam (i.e., each suspension flexure is anchored to the substrate by a pair of anchors at the interior ends of inner arms). (Lin, Fig. 6a and col. 5, ll. 1-2). The reciprocating components move from left to right [i.e., translationally in the direction that the comb fingers extend]. (Lin, Fig. 6a and col. 5, ll. 28-46).

Consequently, the prior art simply fails to teach, disclose or discuss a support structure and elements that are attached at one or more locations sustaining substantially no translational movement during resonant vibration of the elements, and, in fact, the prior art teaches the reciprocating components move translationally in the direction that the comb fingers extend. As such, the Examiner has failed to establish that presently pending claim 28 is anticipated by Lin, and the rejection under 35 U.S.C. § 102 should, therefore, be reversed.

Regarding the claims of Group 3 which depend from claim 28 (i.e., claims 29 and 30), even though the Examiner has not rejected these claims as being anticipated by Lin, Applicant contends that these claims are patentable for at least the same reasons that claim 28 is patentable. Moreover, Applicant contends that these claims recite further limitations, in addition to the limitations of claim 28, which render these claims additionally patentable.

D. Group 4 (claims 31 and 32) is not anticipated by Lin

Although the Examiner has not rejected claims 31 and 32 (Group 4) under 35 U.S.C. § 102(b) as being anticipated by Lin, Applicant contends that claims 31 and 32 are patentable for at least the same reasons that independent claims 1, 5 and 28 are patentable, as argued in detail above. Moreover, Applicant contends that these claims provide further limitations, in addition to the limitations of claims 1, 5 and 28, which render these claims additionally patentable.

IX. CONCLUSION

The Examiner rejected claims 1, 5, 7-9, 11, 13, 15 and 19-32 under 35 U.S.C. § 102(b) as being anticipated by Nguyen. However, the Examiner has failed to establish anticipation under 35 U.S.C. § 102(b). In particular, Nguyen fails to teach or suggest all the elements of presently pending independent claims 1, 5, 28 and 31. In the case of claims 1 and

5, the Examiner has failed to provide evidence that Nguyen discloses a resonator and a support structure both dimensioned so that the resonator is isolated from the support structure during resonator vibration such that energy losses to the substrate are substantially eliminated. In the case of claims 28 and 31, the Examiner has failed to provide evidence that Nguyen discloses a support structure and elements that are attached at one or more locations sustaining substantially no translational movement during resonant vibration of the elements.

The Examiner further rejected claims 1-13 and 15-28 under 35 U.S.C. § 102(b) as being anticipated by Lin. However, the Examiner has failed to establish anticipation under 35 U.S.C. § 102(b). In particular, Lin fails to teach or suggest all the elements of presently pending independent claims 1, 5 and 28. In the case of claims 1 and 5, the Examiner has failed to provide evidence that Lin discloses a resonator and a support structure both dimensioned so that the resonator is isolated from the support structure during resonator vibration such that energy losses to the substrate are substantially eliminated. In the case of claim 28, the Examiner has failed to provide evidence that Lin discloses a support structure and elements that are attached at one or more locations sustaining substantially no translational movement during resonant vibration of the elements. In fact, Lin discloses reciprocating components that move translationally. Therefore, the final rejection of claims 1-32 should be reversed.

A check in the amount of $215 is enclosed to cover the fee of $160 as applicable under the provisions of 37 C.F.R. § 1.17(c) and the fee of $55 for a one month extension under 37 C.F.R. § 1.136(a). Please charge any additional fee or credit any overpayment in connection with this filing to our Deposit Account No. 02-3978. A duplicate of this notice is enclosed for this purpose.

Respectfully submitted,

Clark T.-C. Nguyen

By: ______________________

Thomas W. Saur
Registration No. 45,075
Attorney/Agent for Applicant

Date: August 8, 2003

BROOKS KUSHMAN P.C.
1000 Town Center, 22nd Floor
Southfield, MI 48075-1238
Phone: 248-358-4400
Fax: 248-358-3351

Enclosure - Appendix: Claims On Appeal, U.S. Patent No. 6,249,073

IX. APPENDIX - CLAIMS ON APPEAL

1. A method for filtering signals to obtain a desired passband of frequencies, the method comprising:

providing a micromechanical filter apparatus including a micromechanical resonator having a fundamental resonant mode formed on a substrate and a support structure anchored to the substrate to support the resonator above the substrate; and

vibrating the resonator so that the apparatus passes a desired frequency range of signals while substantially attenuating signals outside the desired frequency range, wherein the support structure is attached to the resonator and the support structure and the resonator are both dimensioned so that the resonator is isolated from the support structure during resonator vibration, wherein energy losses to the substrate are substantially eliminated and wherein the apparatus is a high-Q apparatus.

2. The method as claimed in claim 1 wherein the step of vibrating includes forcing different portions of the resonator to move in opposite directions at the same time so that the resonator vibrates in a resonant mode, m, higher than the fundamental resonant mode wherein the resonator has m+1 nodal points.

3. The method as claimed in claim 2 wherein the micromechanical filter apparatus includes a plurality of input electrodes spaced along the resonator to allow electrostatic excitation of the resonator and wherein the step of forcing includes the steps of applying an in-phase signal to one of the input electrodes to deflect a first portion of the resonator in a first direction and applying an out-of-phase signal to another input electrode to deflect a second portion of the resonator in a second direction opposite the first direction to force the resonator into a correct mode shape.

4. The method as claimed in claim 2 wherein the micromechanical filter apparatus includes an input electrode formed on the substrate to allow electrostatic excitation of the resonator and wherein the step of forcing includes the step of applying a signal to the input electrode, the resonator and the input electrode defines a capacitive transducer gap therebetween and wherein the micromechanical resonator further includes $m+1$ spacers having a height and which extend between the resonator and the substrate at the $m+1$ nodal points and wherein the $m+1$ spacers force the resonator into a correct mode shape during the application of the signal to the input electrode.

5. A micromechanical filter apparatus for filtering signals to obtain a desired passband of frequencies, the apparatus comprising:

a substrate;

a first micromechanical resonator; and

a support structure anchored to the substrate to support the resonator above the substrate wherein the support structure and the resonator are both dimensioned so that the resonator is isolated from the support structure during resonator vibration wherein energy losses to the substrate are substantially eliminated and wherein the apparatus is a high-Q apparatus.

6. The apparatus as claimed in claim 5 wherein the support structure is attached to the resonator at at least one nodal point of the resonator.

7. The apparatus as claimed in claim 5 wherein the signals are RF signals.

8. The apparatus as claimed in claim 7 wherein the apparatus is an RF filter apparatus.

9. The apparatus as claimed in claim 5 wherein the apparatus is a bandpass filter apparatus.

10. The apparatus as claimed in claim 5 wherein the support structure includes at least one beam attached to a nodal point of the resonator.

11. The apparatus as claimed in claim 5 further comprising at least one input electrode formed on the substrate to allow electrostatic excitation of the resonator wherein the resonator and the at least one input electrode define a capacitive transducer gap therebetween.

12. The apparatus as claimed in claim 11 further comprising at least one spacer having a height, each spacer extending between the resonator and the substrate at a nodal point of the resonator wherein the size of the gap is based on the height of the at least one spacer during pull down of the resonator.

13. The apparatus as claimed in claim 5 wherein the resonator is a silicon-based resonator.

14. The apparatus as claimed in claim 5 wherein the resonator is a diamond-based resonator.

15. The apparatus as claimed in claim 11 further comprising at least one output electrode formed on the substrate to sense output of the apparatus.

16. The apparatus as claimed in claim 5 wherein the support structure includes a plurality of beams and the resonator includes a plurality of nodal points and wherein each of the beams is attached to the resonator at one of the nodal points of the resonator so that

the resonator sees substantially no resistance to transverse or torsional motion from the support structure.

17. The apparatus as claimed in claim 11 wherein a pair of balanced input electrodes are formed on the substrate to allow electrostatic excitation of the resonator.

18. The apparatus as claimed in claim 15 wherein a pair of balanced output electrodes are formed on the substrate to sense output of the apparatus.

19. The apparatus as claimed in claim 5 further comprising a second micromechanical resonator, the first and second resonators forming a pair of intercoupled end resonators.

20. The apparatus as claimed in claim 19 wherein the support structure supports the end resonators above the substrate.

21. The apparatus as claimed in claim 19 further comprising an inner resonator intercoupled to the end resonators.

22. The apparatus as claimed in claim 21 wherein the support structure supports the end and inner resonators above the substrate.

23. The apparatus as claimed in claim 21 further comprising a plurality of coupling links for coupling the inner resonator to the end resonators.

24. The apparatus as claimed in claim 23 wherein the coupling links are operable in multiple modes.

25. The apparatus as claimed in claim 23 wherein the coupling links are higher mode coupling beams.

26. The method as claimed in claim 1 wherein the resonator has a Q greater than 5000.

27. The apparatus as claimed in claim 5 wherein the resonator has a Q greater than 5000.

28. A micromechanical filter apparatus for filtering signals to obtain a desired passband of frequencies, the apparatus comprising:

a substrate;

a plurality of intercoupled micromechanical elements capable of resonant vibration; and

a support structure anchored to the substrate to support the elements above the substrate wherein the support structure and the elements are attached at one or more locations sustaining substantially no translational movement during resonant vibration of the elements.

29. The apparatus as claimed in claim 28 wherein the plurality of intercoupled micromechanical elements comprises a first resonant beam and a second resonant beam, wherein the support structure comprises a first support beam and a second support beam attached to the first resonant beam and the second resonant beam, respectively, and wherein the first and second support beams sustain substantially no translational movement during resonant vibration of the elements.

30. The apparatus as claimed in claim 29 wherein the plurality of intercoupled micromechanical elements comprises a third resonant beam coupled to the first resonant beam and the second resonant beam via a pair of coupling beams.

31. A micromechanical filter apparatus for filtering signals to obtain a desired passband of frequencies, the apparatus comprising:

a substrate;

a plurality of intercoupled micromechanical elements capable of resonant vibration; and

a support structure anchored to the substrate to support the elements above the substrate wherein the support structure comprises a support beam, and wherein the support beam is attached to the elements such that the support beam sustains substantially no translational movement during resonant vibration of the elements.

32. The apparatus as claimed in claim 31 wherein the plurality of intercoupled micromechanical elements comprises a first resonant beam, a second resonant beam, and a third resonant beam, and wherein the third resonant beam is coupled to the first resonant beam and the second resonant beam via a pair of coupling beams.

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